

- 1 -

TITLE OF THE INVENTION**MANOMETRIC GAS INSUFFLATOR**

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TECHNICAL FIELD OF THE INVENTION

10 This invention relates to a gas insufflator particularly
for use in laparoscopic surgery.

BACKGROUND OF THE INVENTION

15 Laparoscopic surgery which has the advantage of being
minimally invasive has become a predominant surgical
technique. It is a procedure that is universally
practiced in many hospitals. However, laparoscopic
surgery requires a team of competently trained personnel
including a consultant surgeon. There is a growing need
20 to train junior doctors to assist in laparoscopic
surgery.

The main stumbling block to laparoscopic surgery
training is the need for expensive equipment in the work
25 stations in which the training takes place. This need
for very expensive equipment places financial strains on
training hospitals and is a constant barrier to quality
training.

30 Traditionally, one of the more expensive pieces of
equipment used in laparoscopic surgery is an abdominal
gas insufflator. It is thus considered that there is a
need for a cheap, portable, yet precise gas insufflator
that can be readily used for the training of the
35 surgical skills required for laparoscopic surgery.

It is this need that has brought about the present invention.

SUMMARY OF THE INVENTION

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According to the present invention there is provided a gas insufflator comprising a portable frame supporting gas circuitry including a gas inlet and a length of flexible tubing as a gas outlet, the gas inlet being adapted for independent interconnection to two sources of gas, the frame having a front face that supports an adjustable flow meter coupled to a distribution valve assembly, the distribution valve assembly including gas release means being coupled to a manometer and the length of flexible plastics tubing that is arranged to provide the gas under pressure to a patient whereby gas can be provided to the patient at a controlled flow rate from one of two gas sources with continuous monitoring of the supply pressure.

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BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawings in which:

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Figure 1 is a side on view of a gas insufflator; and

Figure 2 is a front view of the gas insufflator.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The gas insufflator as shown in the accompanying drawings has been specifically designed to be made from readily available components so that the device can be manufactured as cheaply as possible yet provide the

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accuracy that is required in operational procedures.

The purpose of the insufflator is to inflate the abdomen during surgical procedures. It is thus necessary to
5 ensure that there is an adequate source of air or gas under pressure and that the pressure can be monitored and controlled so that over or under inflation of the abdomen does not occur. In some situations there is a need to use a compressed gas like CO₂ that can be
10 obtained from a cylinder or in other cases air will suffice. For this purpose a diaphragm air pump is provided which is electrically operated to supply a continuous supply of air.

15 As shown in the accompanying drawings the insufflator 10 comprises a T-shaped skeletal frame 11 with a base 12 and a vertical flange 15 that defines the front face 16 of the insufflator as shown in Figure 2. The rear 17 of the insufflator is enclosed in a perspex box 20 having a
20 rear wall 21 and a top 22. The sides 23, 24 are left open to provide ready access to the contents of the perspex box 20 and a handle 25 is positioned on the top 22 of the box to facilitate lifting of the assembly. The perspex box 20 is secured by adhesive to the T-
25 shaped skeletal frame 11. The enclosure defined by the perspex box 20 contains a small electrically operated diaphragm air pump 30 that has a dual outlet 31, 32 fed into a single tube 33 via a Y-joint 36 and attached to a fixed nipple 34 on the rear of an inlet connector 35 at
30 the rear 17 of the flange 15.

Although not shown in the drawing it is understood that the outlet tubing 39 from a gas cylinder can also be coupled to the nipple 34 by simply removing and
35 replacing the air pump tubing 33 with the outlet tubing 39. The interior of the perspex box 20 is also used to

locate a long length (approximately 5 feet in length) of silicone tubing 56 for patient insufflation that extends through a hole 58 in the front face 16 of the box 20 as shown schematically in Figure 1. Although not shown, the silicone tubing 56 can be coiled around the tube holder 59 for storage and is sufficiently long to reach the patient.

The front face 16 of the insufflator supports a flow meter 40 and a flow meter gauge 41, the output 42 of which is coupled to a 50mm diameter cellulose acetate filter cap 43 which has a pore size of 0.2 micron for sterile gas delivery via flexible silicone tubing 44 to a six way distribution tap assembly 50 that includes four taps 51, 52, 53 and 54 at an outlet 55 that is coupled to silicone tubing 56 that extends through the hole 58 in the front face 16 to the rear of the apparatus where it is coiled around the tube holder 59 and stored prior to use.

The flow meter 40 is manufactured by Harris Calorific U.S.A and is graduated for step up flow rates of 0.5 litres per minute up to a maximum of 15 litres per minute. A calibrated gauge 41 shows the flow rate and a control knob 46 provides the incremental adjustments.

The lower tap 54 of the tap assembly 50 is coupled to a manometer assembly 70 via tubing 57. The manometer assembly 70 comprises a small sealed box 71 of clear perspex which is located at the base 12 of the frame 11 to support a vertically extending U-tube 72 which acts as a manometer. The sealed box 71 has a port 73 for gas inlet from the tap 54 and a second port 74 that receives water from a reservoir 75 in the form of a 30 millimeter syringe that is coupled to the top of the manometer tubing 72 via a clamp 76. The reservoir 75 delivers

water into the sealed box 71 to correspond to the zero reading of the manometer tube 72 and to replenish the box when the zero level fluctuates. The water is tainted with 0.1% methylene blue for easy viewing of the pressure readings on the manometer against a white background. Gas inflow will exert a pressure on the water in the sealed box 71 causing it to rise up the manometer tube 72 which is graduated to give pressure readings in centimetre water and a corresponding calculated millimetre mercury reading. The closed circuitry of the manometer assembly 70 ensures that the recorded pressure readings reflects the pressure of the insufflated abdominal cavity. The manometer assembly 70 is a very simple yet accurate means of showing the abdominal pressure without the need for sophisticated mechanical or electronic pressure gauges. The use of water to provide manometric pressure readings provides a very sensitive response to slight fluctuations in pressure in contrast with the sluggish responses of mechanical gauges.

Insufflators of the kind described above need a provision for initial high gas flow for immediate inflation of the abdomen and then a sustainable moderate flow to maintain the abdominal distension within acceptable pressure limits. The insufflator described above provides a high gas flow of between 11 and 15 litres per minute. When a compressed carbon dioxide gas source is used, the inlet pressure of 0.3 bar (30 kPa) provides a maximum flow rate of 15 litres per minute. When the air pump is used at full capacity the maximum flow rate is 11 litres per minute. Once the initial inflation abdomen pressure has been reached it is usual to reduce the flow rate to about 5 litres per minute. This flow rate can be supplied by either the CO₂ supply or the air pump depending on the needs. Importantly,

the air pump provides a continuous supply of air flow and thus there is no danger of running out of gas as in the case of a cylinder of CO₂. Whilst CO₂ is the more popular choice of gas in laparoscopic surgery recent
5 research has indicted that tests carried out on pigs allow laparoscopic surgery with air insufflation without any adverse reactions.

The distribution tap assembly 50 provides three taps 51,
10 52 and 53 that are used for excess gas purging to ensure pressure equilibrium. The gas purging feature allows for regulated discharge of excess gas to establish a pressure equilibrium when the gas flow and the pressure
15 of the abdomen and the manometer are in a state of equalised balance. The pressure equilibrium is sustainable over a long period of time with a continuous gas flow to counter balance any pressure loss due to surgical manipulation as in irrigation and suction of
blood leaks.

20 The insufflator described above uses the minimum of components and is dimensioned to be 45cm high, 25cm in length with a depth of 12cm. The insufflator weighs approximately 5kg and the handle 25 on the top of the
25 perspex box 20 provides transportability. The insufflator is also 20cm in cross section which also contributes to its portability.

Extensive testing has been carried out to check the
30 accuracy of the insufflator against calibrated pressure and flow monitoring systems. The insufflator described above performs very favourably against much more sophisticated and considerably more expensive equipment.

35 To minimise the cost of the insufflator, readily available laboratory materials were used in its

construction. The manometer was obtained from a central
venus pressure set and the skeletal frame with the
perspex boxes were constructed in the laboratory
workshop. The sterile filter cap and the silicon tubing
5 are both components commonly used in tissue culture
laboratories.

The celluloid acetate filter appears to be an effective
barrier to generate sterile air discharge, although it
10 was discovered that the filter tends to slow the gas
rate down by about 2 litres per minute when the
diaphragm pump is in use. It is thus suggested that
when the insufflator is used to train surgical skills on
an animal, the sterile filter could be detached for
15 higher gas flow.

The dual supply of CO₂ and air renders the insufflator
suitable for use not only in hospitals but also in
outdoor situations such as for veterinary use where
20 compressed air supplies are not available. The
diaphragm pump provides a continuous uninterrupted gas
flow for long surgical operations.

The cost of the insufflator is a fraction of the
25 commercially available models and thus makes the
insufflator attractive for use in surgical skill
training and veterinary procedures. Furthermore, the
safety features such as the use of sterile gas delivery
and excess gas purging with sustainable flow renders the
30 apparatus as qualified for clinical use. It is
understood however that other more sophisticated
features could be incorporated into the equipment such
as means for automated gas control and alarms for over
insufflation. These features would be particularly
35 desirable where the equipment is put to clinical use.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A gas insufflator comprising a portable frame supporting gas circuitry including a gas inlet and
5 a length of flexible tubing as a gas outlet, the gas inlet being adapted for independent interconnection to two sources of gas, the frame having a front face that supports an adjustable flow meter coupled to a distribution valve
10 assembly, the distribution valve assembly including gas release means and being coupled to a manometer and the length of flexible tubing that is arranged to provide the gas under pressure to a patient whereby gas can be provided to the patient at a
15 controlled flow rate from one of two gas sources with continuous monitoring of the supply pressure.
2. The gas insufflator according to claim 1 wherein the gas inlet is adapted to be independently
20 connected to an electric air pump or a cylinder of compressed gas.
3. The gas insufflator according to either claim 1 or claim 2 wherein a filter is positioned between the
25 gas inlet and the gas outlet.
4. The gas insufflator according to claim 3 wherein the filter is positioned between the flow meter and the distribution valve assembly.
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5. The gas insufflator according to any one of the preceding claims wherein the manometer comprises a sealed compartment containing water, the
35 compartment being adapted to receive gas under pressure and including a manometer tube which can overflow back into the sealed chamber via a water



reservoir.

6. The gas insufflator according to claim 2 wherein
the electrically operated air pump is positioned at
5 the rear of the frame.
7. The gas insufflator according to any one of the
preceding claims wherein the length of flexible
tubing is located when not used in a coil at the
10 rear of the frame.
8. The gas insufflator according to any one of the
preceding claims wherein a carry handle is provided
to assist the portability of the insufflator.
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9. A gas insufflator comprising a portable frame
supporting gas circuitry including a gas inlet and
a length of flexible tubing as a gas outlet, a
source of pressurised gas and an electrically
20 driven air pump both being adapted to be connected
independently to the gas inlet to provide two
independent sources of gas, the frame having a
front face that supports an adjustable flow meter
coupled to a distribution valve assembly, the
25 distribution valve assembly including gas release
means and being coupled to a manometer and the
length of flexible tubing that is arranged to
provide the gas under pressure to a patient whereby
gas can be provided to the patient at a controlled
30 flow rate from either the source of gas under
pressure or the air pump with continuous monitoring
of the supply pressure.

